



# SQUARE ONE SYSTEMS DESIGN

When South Korean-based electronics giant Samsung was looking for the perfect robot to fit its needs, it went far beyond its borders in technology-rich Asia. It went all the way to Jackson, Wyoming. That's where Square One Systems Design spearheads its development of innovative automated systems, precision positioning devices, and robots for diverse industries. The company has utilized the Small Business Innovation Research (SBIR) program to not only gain insight into worldwide applications, but to increase its own visibility in the vast global marketplace.

## PHASE III SUCCESS

Over \$3 million in revenue resulting from technologies originally funded by the SBIR program.

## AGENCIES

DOE, NSF, NASA, HHS (NIH)

## SNAPSHOT

Wyoming-based Square One Systems Design is a world leader in robotic automation inspired by the surrounding natural beauty of Yellowstone and Grand Teton National Parks.

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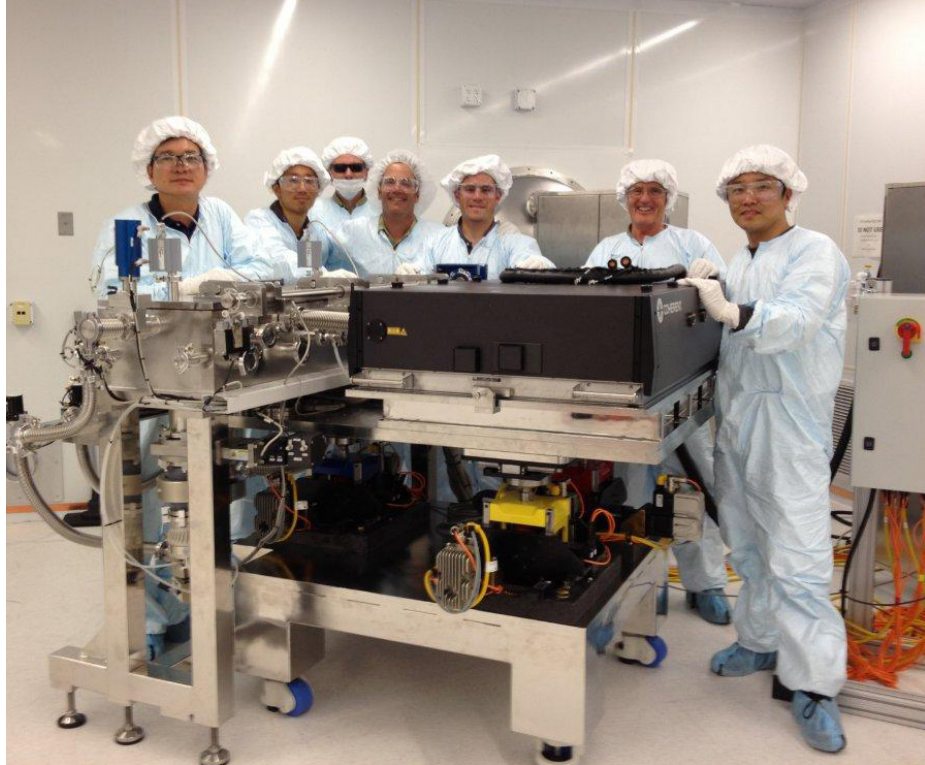
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"One of the great things about SBIR is that the opportunities come to you," says Bob Viola, Director of Engineering for Square One Systems Design. "Solicitations are published online and we can locate opportunities that align with our expertise, so for a company like ours, which is located remotely from the end user, the SBIR program offers that advantage for exposure and that has been huge for us."

After successfully completing SBIR projects with various U.S. agencies including DOE, DOD, NSF, NASA and NIH, Square One has developed a full suite of robotic applications. The company's first SBIR project with DOE enabled the development of an innovative six-axis robot, masquerading as an inanimate object.

"We developed our 'Tri-Sphere' parallel robot, which is actually a table that can be moved and positioned in all six degrees-of-freedom, and can hold 5,000 pounds," explained Viola. "We envisioned it would be used in DOE laboratories. We were lucky enough to partner with Lawrence Berkeley National Laboratory in a partnership with Samsung, and we've used additional SBIRs to refine the design. Now we have what we hoped for – a portfolio of technologies."

The Tri-Sphere Positioning System, developed under SBIR funding, is a fundamentally new type of positioning technology specifically designed to meet the stringent requirements of 3rd and 4th generation synchrotron light sources. The mechanisms used to support and position mirrors, monochromators, and other beam conditioning components are critical to the performance of synchrotron beamlines. However, the performance of these mechanisms is often not equal to the demands placed upon them by modern synchrotron designs. This results in temperamental beamlines that are difficult to align, and are susceptible to vibrational and thermal disruptions, and incapable of achieving operational goals.



**LEFT** Square One's employee Charlie Hagen installing the company's patented Sample Exchange Robot.

**RIGHT** The team at Square One Systems Design showcases its Tri-Sphere Positioning System – this SBIR-funded technology is an innovative six degrees-of-freedom precision alignment system specifically tailored for synchrotron applications.

The Tri-Sphere, by contrast, delivers precision adjustment in all six degrees-of-freedom while providing rock solid stability. While derived from the same class of mechanisms as hexapods, the Tri-Sphere's innovative design allows it to transcend the limitations of conventional six-axis positioners. Comprised exclusively of prismatic actuators, the Tri-Sphere is almost infinitely scalable and can generate large, highly asymmetric work envelopes.

Square One sold several units of its Tri-Sphere Positioning System to Samsung and traveled to South Korea to install the devices, where Samsung is using it to position very powerful lasers.

Another bread and butter device for the company is its Sample Exchange Robot. Current generation synchrotron light sources provide X-ray beams of unprecedented brightness, allowing experimental data sets to be gathered in a matter of minutes. However, fresh samples are still generally loaded manually; a time-consuming process that compromises the productivity of valuable X-ray resources. Square One's fully automated Sample Exchange Workcell provides a fast, reliable solution by pulling a selected sample from the magazine, reading its barcode, and correctly orienting it and transferring to the experiment.

Another powerful innovation is Square One's Detector Positioning Robot – an advanced 6-axis device offering a new approach for positioning detectors. Under robot control, a detector can be rapidly repositioned throughout an exceptionally large detection volume. This system delivers accuracies and repeatability equal to that of hard-tooled detector positioning mechanisms. However, unlike these mechanisms, the robot's center of rotation can be instantly re-defined when a sample's location changes. This results in systems that provide maximum operational flexibility.

Although the SBIR program has had a crucial hand in the company's success, Viola is quick to point out that its location in the great state of Wyoming has had instrumental impact on the growth of Square One.

"The state is very uniquely suited for a smart technology start up, because unlike some states, Wyoming runs a multi billion dollar surplus," adds Viola. "There is a very active program called the Wyoming SBIR/STTR Initiative, or WSSI for short. It offers all sorts of resources and support for companies that want to play in the SBIR arena. It deals with how to write winning proposals."

The state also has a Phase 0 Program where companies come to the WSSI and put together mini proposals. Experts at the University of Wyoming then review proposals, and winners receive up to \$5,000 to help offset the inevitable costs with putting together a Phase I SBIR proposal. For a state with only 500,000 people, Viola feels Wyoming attracts the best of the best of high-tech entrepreneurs with a drive to succeed. Part of the vision of the company is to assemble the best minds in the business in an idyllic location, equip them with the latest design tools, and then turn them loose on the most challenging automation projects. The leaders at Square One believe their unconventional setting fosters original thinking and collaborators, which include ONR and Stanford University, always enjoy their visits.

The next sector to conquer according to Viola is the auto assembly industry, although any commercial product that is assembled using automation would be a target opportunity. Square One's niche market of physics research and semi conductor manufacturing is continuing to grow exponentially so there are no shortage of opportunities for this highly innovative and results driven company.